PATENT ABSTRACTS OF JAPAN

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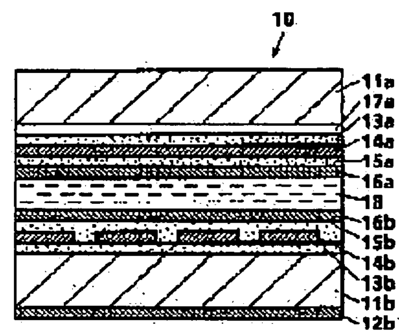
(71)Applicant : FUJI PHOTO FILM CO LTD
(72)Inventor : KAWAGUCHI HIDEO
YAGO ATSUSHI

(54) LIQUID CRYSTAL DISPLAY ELEMENT

(57)Abstract:
PURPOSE: To provide a liquid crystal display element (liquid crystal panel) which can be controlled entirely to uniform temperature and further provide a liquid crystal display element whose transmitted light is colored little.
CONSTITUTION: Two glass substrates 11a and 11b which have transparent electrode layers 14a and 14b and oriented films 16a and 16b provided on one-surface sides are arranged having the oriented films 16a and 16b opposite each other and liquid crystal is charged in the gap between the oriented, films 16a and 16b to constitute the liquid crystal display element; and a heater electrode layer 12b constituted by arranging ≥3 rectangular heater electrodes laterally in parallel is provided on the surface of at least one of the glass substrates, the heater electrode layer 12b is divided into at least three independent heating areas in heater electrode units, and the divided heating areas at both the ends are narrower than other heating areas. Further, the film thickness of the transparent electrodes and the film thickness of the heater electrodes are so adjusted that the difference between the maximum transmissivity and minimum transmissivity in the 400-800nm wavelength range of white light transmitted through the liquid crystal display element is ≤20%.



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Japanese Publication for Unexamined Patent Application No. 173153/1993 (*Tokukai* 5-173153)

A. Relevance of the Above-identified Document

This document has relevance to all of the claims of the present application.

B. Translation of the Relevant Passages of the Document

See the attached English Abstract.

[0026] (DETAILED DESCTRIPTION OF THE INVENTION)

The present invention is described with reference to attached drawings. Fig. 1 is an enlarged cross sectional view schematically showing part of an embodiment of a liquid crystal display element in accordance with the present invention. In Fig. 1, a liquid crystal display device 10 includes a glass substrate 11b in which a heater electrode layer 12b is arranged on a surface of one side; and an insulation film13b, a transparent electrode layer 14b, an insulation film 15b, and an alignment film 16b are arranged in this order on a surface of another side. The liquid crystal display device 10 further includes another glass substrate 11a on which a color filter 17a, an insulation film13a, a transparent electrode layer 14a, an insulation film 15a, and an alignment film 16a are provided in this order. A gap between the alignment film 16a and the alignment film 16b is filled with liquid crystal

18.

[0027] The heater electrode layer is provided with a plurality of straight strip-shape heater electrodes; and the heater electrodes are arranged in parallel, preferably, parallel to a longitudinal direction (shorter edge) of the element. As described regarding Fig. 3 later, the heater electrode layer is divided into at least three heating regions. In each of the heating regions, both ends of the heater electrodes are connected to metal electrode terminals collectively. The heater electrodes are respectively made of a conductive transparent film such as ITO. This film generates heat as a current is supplied. A temperature of an entire element is kept constant by supplying an impressed voltage to regions on both edges of the liquid crystal element, and supplying a different impressed voltage to a region in a middle of the liquid crystal element (specifically, a high-voltage for the regions on both edges, and a low-voltage for the region in the middle). An amount of heat generation may be changed by supplying a constant voltage for a different time period, or by changing pulse length. In such cases, it is preferable that a temperature-detecting device (made of ITO film) be provided on a non-display area of the glass substrate or the color filter.

[0028] Fig. 2 is an enlarged cross sectional view schematically showing part of another embodiment of a liquid crystal display element in accordance with the present invention. In Fig. 2, the liquid crystal display device 20 includes a glass substrate 21b on which a heater electrode layer 22b, an insulation film 23b, a transparent electrode layer 24b, an insulation film 25b, and an alignment film 26b are provided in this order. The liquid crystal display device 10 further includes another glass substrate 21a on which a color filter 27a, an insulation film 23a, a transparent electrode layer 22a, an insulation film 25a, and an alignment film 26a are provided in this order. A gap between the alignment film 26a and the alignment film 26b is filled with liquid crystal 28. This is an embodiment in which the heater electrode layer is provided on the surface facing toward the liquid crystal. It is more effective in heating the liquid crystal than the embodiment in Fig. 1. However, this embodiment requires a high accuracy in a production.

[0029] Fig. 3 is a plan view schematically showing a substrate having a heater electrode layer of the liquid crystal display element of an embodiment in accordance with the present invention. In Fig. 3, rectangle (straight strip-shape) heater electrodes 32H, 33H, and 34H are

formed on a glass substrate 31b. To form a transparent electrode substrate, an insulation film is further provided, and straight strip-shaped transparent electrodes are formed on the insulation film. The heater electrode layer is divided into three heating regions 32, 33, and 34; and the heater electrodes 22H, 33H, and 34H are corresponding to each of the heating regions. The heater electrodes are combined at both ends by metal electrode terminals 32A, 33A and 34A, as well as 32B, 33B, and 34B. 32A is connected to 32B, 33A is connected to 33B, and 34A is connected to 34B; and each of the terminals is connected to the heater. When the heater electrode layer has one region, a heat generation amount does not decrease in a vicinity of connecting portion, while a vicinity of side-end portions in relation to short edges generating less heat. This information made clear that an object of this invention is achieved by the arrangement in which the heater electrode layer, in which a plurality of the rectangle heater electrodes are arranged in the longitudinal direction, are divided into three heating regions; and a voltage impressed to the regions on both edges is higher than a voltage impressed to the other middle areas. It is thus preferable that the regions on both sides be not too wide, and the width be within a

range of 3 to 30 mm. Since the temperature tends to drop more in areas in a distance of 3 to 4 mm from the end portions of the both sides. It is preferable that an area of the heater electrode layer be larger than an area of display area, by the areas on the both sides. It is further preferable that the heater electrodes be line symmetric. Needless to mention that such problem is solved by increasing a number of divided regions in such arrangement that the regions closer to the end portions having narrower widths, and generates more amount of heat. However, it should be noted that such arrangement could be disadvantageous in terms of productivity. To automatically control the impressed voltage to the three regions, it is preferable that the temperature-detecting device be provided, in positions, corresponding to these regions, on a non-display area of the glass substrate or the color filter.

[0030] The heater electrodes of this invention is not limited to the ITO film, and the heater electrodes may be a film of an oxidized metal such as indium oxide, tin oxide, and titanium oxide.

[0031] In the heater electrodes made of the ITO film, width (short edge) of the rectangle is generally between a range of 0.2 to 2.0 mm, preferably between a range of 0.5 to 1.5

mm; distances in between the electrodes are generally between a range of 0.01 to 1.0 mm, preferably between a range of 0.2 to 0.8mm; and the film thickness is generally between a range of 50 to 500nm, preferably between a range of 50 to 250 nm. The heater electrode layer itself, made of the heater electrodes, can be produced by a well-known method; for example, coating method, vacuum depositing method, High frequency spattering method, and magnetron spattering method, or the like. Further, it is preferable that a range of sheet resistibility value be between a range of 10 to 100 Ω/□, although the preferred range varies depending on a size of the liquid crystal display.

[0032] The temperature-detecting device is an ITO film. The temperature is detected by measuring a current value of a current, the current being supplied to the ITO film whose electric resistance changes depending on the temperature. For example, a minute current supplied to ITO film is amplified and converted into a temperature value, by comparing it with a verification line. The temperature value thus converted can be digitally displayed. The current value passing the ITO film is compared with a predetermined-temperature corresponding to the current value worked out from the

verification line; and on-off operation of the heater, arranged outside the liquid crystal display element, is controlled so as to compensate a difference between the current value and the predetermined-temperature. Namely, the voltage is increased, if the temperature detected by the temperature-detecting device is lower than the predetermined temperature; and the voltage is decreased or stopped so that the liquid crystal display element will stand to cool, if the temperature detected by the temperature-detecting device is higher than the predetermined temperature. The temperature is thus maintained in a predetermined range of the temperature. These operations can be automatically carried out by using a computer. Means to control the temperature may be means of a proportional control, a PID control, a fuzzy control, and so on. Further, instead of arranging the heater, the temperature of the liquid crystal can also be maintained within the predetermined range by comparing the temperature value obtained by the temperature-detecting device, with a temperature within the predetermined range, then controlling an output of a liquid crystal driver for driving the liquid crystal display device, in accordance with a difference between the both of the temperature. The temperature-detecting device of

this invention may be arranged in any places between the substrate and the transparent electrode. The temperature-detecting device can be arranged anywhere as long as it is between the substrate and the transparent electrode. Generally, it is preferable that the temperature-detecting device not be in contact with the transparent electrode, and that the temperature-detecting device and the transparent electrode be intervened by an insulation layer. The temperature-detecting device may be arranged between the substrate and the transparent electrode on the substrate, instead of arranging the temperature-detecting device on the substrate.

[0033] The temperature-detecting device is not limited to the ITO film, and the temperature-detecting device may be formed in a microscopic structure of metal such as a thin wire of metal such as Pt, Cu, Ag, or the like; a thin film of metal such as Au, Pd, Al, Ag, or the like; a thin film of an oxidized metal such as indium oxide, tin oxide, titanium oxide, or the like; or other material, provided that the temperature can be measured, (particularly, the temperature can be measured in an electric volume as a matter of convenience).

[0034] The metal electrode terminal is made of a metal such as Pt, Cu, Ag, Au, Pd, Al, Cr, Mo, Ni or the like. The

metal electrode terminal can be any material as long as the electric resistance of the material is low, and the current can easily flow.

(BRIEF DESCRIPTION OF THE DRAWINGS)

Fig. 1 is an enlarged cross sectional view schematically showing part of a liquid crystal display element of an embodiment in accordance with the present invention.

Fig. 2 is an enlarged cross sectional view schematically showing part of the liquid crystal display element of an embodiment in accordance with the present invention.

Fig. 3 is a plan view schematically showing a substrate having a heater electrode layer of the liquid crystal display element of an embodiment in accordance with the present invention.

(REFERENCE NUMERALS)

10 Liquid crystal display element

11a, 11b, 21a, 21b, 31b Glass substrate

12b, 22b heater electrode Layer

13a, 13b, 15a, 15b, 23a,

23b, 25a, 25b, 27b Insulation film

14a, 14b, 24a, 24b Transparent electrode layer

16a, 16b, 26a, 26b Alignment film

18, 28 Liquid crystal

17a, 27a Color filter

32H, 33H, 34H Heater electrode

32A, 33A, 34A, 32B, 33B, 34B Metal electrode terminal

32, 33, 34

Divided heating regions of the heater electrode layer

Fig. 1

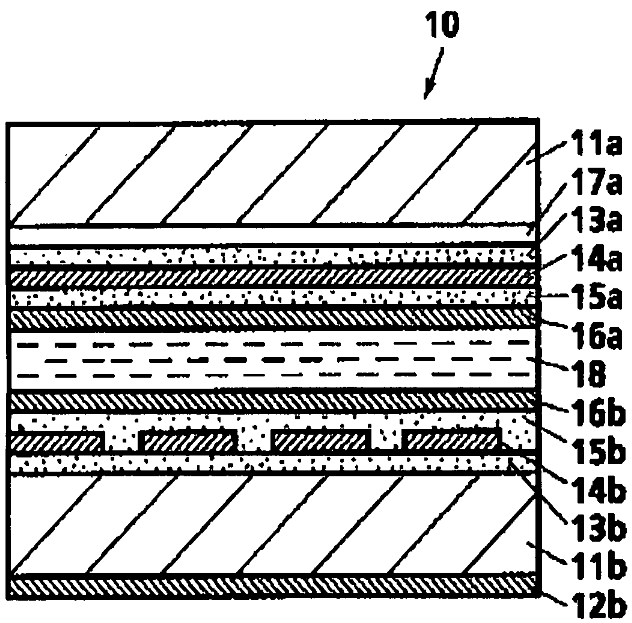
10
11a
17a
13a
14a
15a
16a
18
16b
15b
14b
13b
11b
12b

Fig. 2

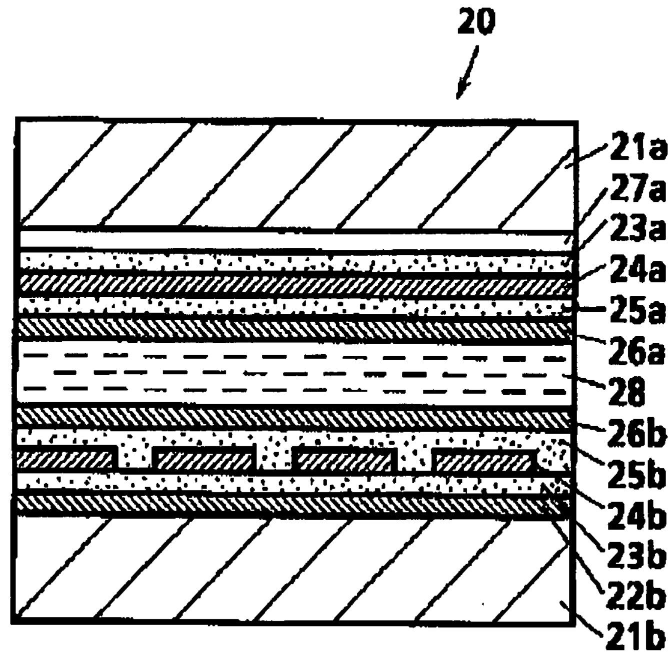
20
21a
27a
23a
24a
25a
26a
28
26b
25b
24b
23b
22b
21b

Fig. 3